Small Business Innovation Research/Small Business Tech Transfer

Intelligent Power Source Reliability Monitoring and Failure Mitigation System, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

Alphacore Inc. will develop a high-accuracy built-in self-test (BIST) system for characterization of aging, degradation, available power and in-situ diagnosis of photovoltaic and multi-pack battery systems using low-complexity single-chip impedance spectroscopy (IS) approach. Alphacore will collaborate with Arizona State University (ASU) scientists to develop *a low complexity single-chip photovoltaic cell self-test and instrumentation module to achieve*:

a) In-situ health and reliability monitoring of solar panel and reporting cell status.

b) In-situ characterization of complex impedance characteristics of solar panel or cell over extended periods of time.

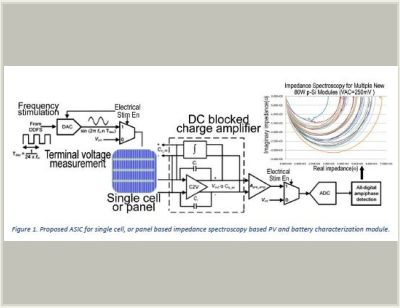
c) A periodic self-diagnostic mode to characterize the connectivity of the solar panel or cell.

d) A digital interface that can generate immediate response to failing cells or panels and short / disconnected cells.

e) A model to utilize state parameters including terminal voltage, load current, and PV complex impedance model for correlating the efficiency of the battery.

Alphacore Inc. will also develop techniques to extend these approaches to detecting and monitoring Li-Ion battery packs and other charge storage and distribution systems' health status. The IS device will provide real-time monitoring capability of solar cell and panel C-V and capacity conditions. In response to the output of this module, the safety and connectivity modifications will be made while still maintaining cell-level specific energy.

Alphacore's PV monitoring ASIC will be able to characterize the complex impedance of individual cells and panels from DC to 100kHz, with 11bit (0.05%) accuracy. The spectral self-test would be completed in less than 1 Secs, and will take less than 4mA of DC current during operation. By monitoring the complex impedance for a given terminal voltage and current, a comprehensive model for the aging of the PV cells will be formed and updated.



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Anticipated Benefits

- ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS)
- Geostationary Carbon Cycle Observatory (GeoCARB)
- Hyperspectral and thermal infrared imagers (HyspIRI)
- Multi-Angle Imager for Aerosols (MAIA)
- Interferometric Synthetic Aperture Radar (InSAR)
- NASA-ISRO Synthetic Aperture Radar (NISAR)
- Pre-Aerosol, Clouds, and ocean Ecosystem PACE (Pre-ACE)
- Tropospheric Emissions: Monitoring of Pollution (TEMPO), and many more…

*High Energy Physics (HEP) experiments (e.g., CERN) particle detection

*Medical irradiation and imaging systems

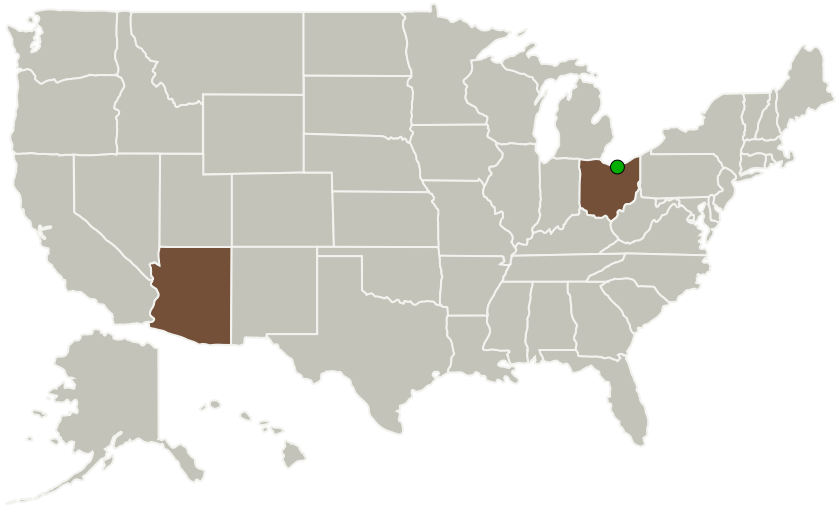
*Nuclear weapon proliferation monitoring

*Space-based sensors

*LEO telecommunications satellites

*GEO telecommunication satellites

Primary U.S. Work Locations and Key Partners



Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Alphacore, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

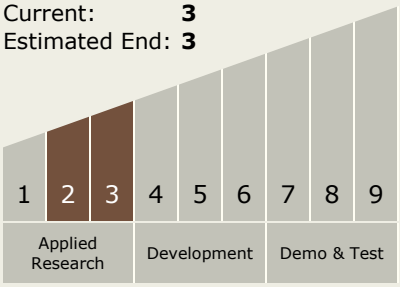
Carlos Torrez

Principal Investigator:

Esko Mikkola

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Organizations Performing Work	Role	Type	Location
Alphacore, Inc.	Lead Organization	Industry	Tempe, Arizona
Arizona State University-Tempe(ASU)	Supporting Organization	Academia	Tempe, Arizona
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Arizona	Ohio

Project Transitions

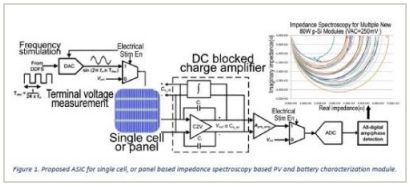
July 2018: Project Start

August 2019: Closed out

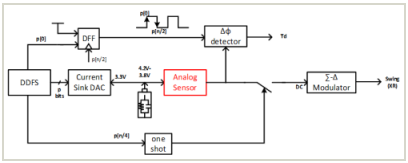
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137842)*

Images



Briefing Chart Image
Intelligent Power Source Reliability Monitoring and Failure Mitigation System, Phase I
(https://techport.nasa.gov/image/135607)



Final Summary Chart Image
Intelligent Power Source Reliability Monitoring and Failure Mitigation System, Phase I
(https://techport.nasa.gov/image/127027)

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.1 Power Generation and Energy Conversion
    - TX03.1.1 Photovoltaic

Target Destinations

Earth, The Moon, Mars